

Name

Current school



WELLINGTON COLLEGE

13+ SCHOLARSHIP EXAMINATION 2023

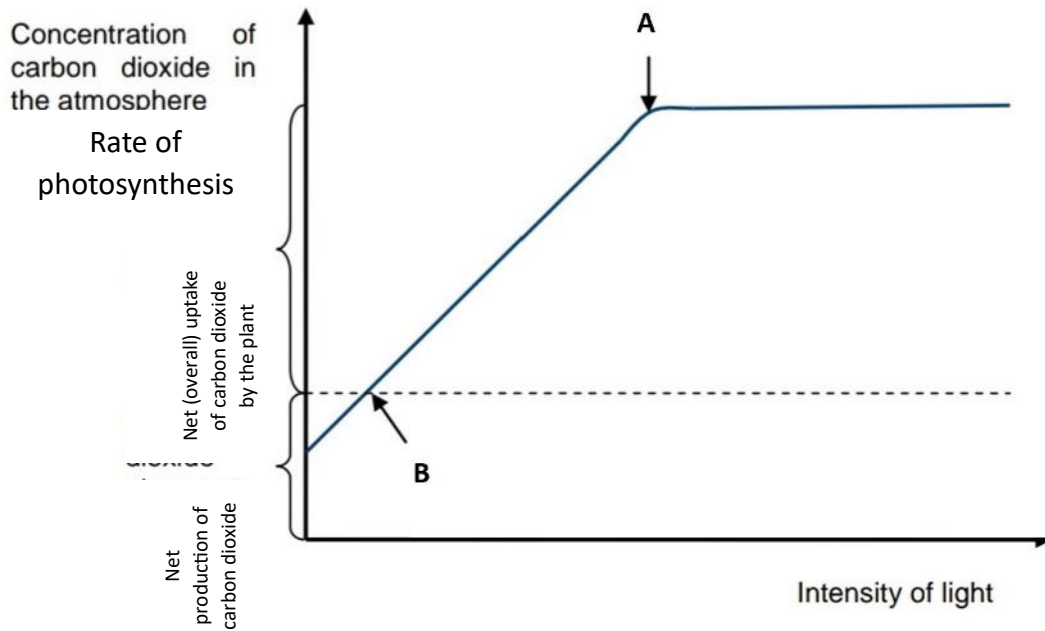
SCIENCE

TIME ALLOWED: 45 minutes

TOTAL MARKS: 46, marks for each question are shown in brackets

- **Read the questions carefully and answer in the spaces provided**
- **Calculators may be used**
- **A copy of the periodic table is provided at the back of the paper**

Q1. A plant was grown in a greenhouse and subjected to different light levels. The volume of carbon dioxide was measured at each different light intensity and the results recorded on the graph below.



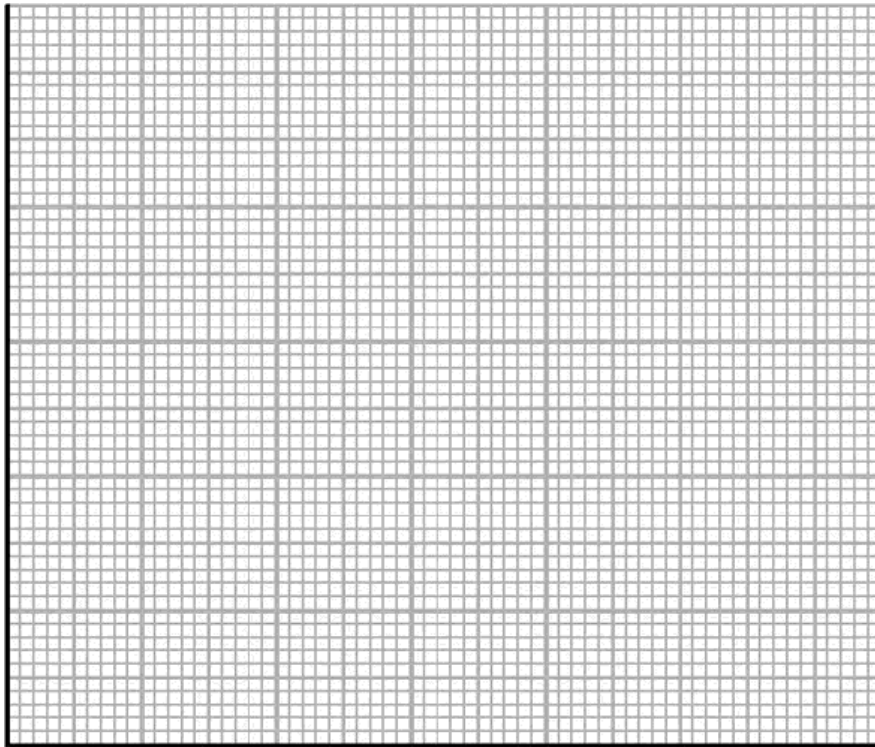
(a) Using your biological knowledge, explain what is happening at points A and B.

A.....

B.....

(b) Using the graph paper below, sketch a graph of the rate of carbon dioxide usage by a plant through photosynthesis over the course of a 24 hour period. Label this line "P".

[3]



(c) On the same graph, add a line to show the rate of carbon dioxide production by respiration over the same period. Label this line "R".

[3]

(d) A farmer wanted to know if atmospheric carbon dioxide levels affected how much of his crop was eaten by insects.

Describe an investigation you could carry out to see if this is true.

Make sure it is a test that would give the farmer reliable results.

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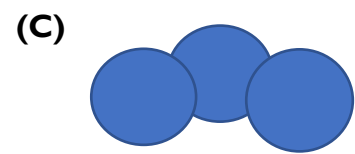
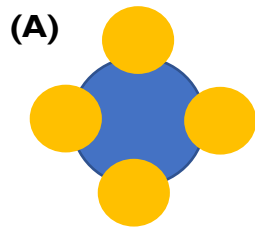
Q2. Carbon dioxide is a colourless gas which can be found in our atmosphere.

(a) Circle the word(s) that best describe carbon dioxide.

Molecule Compound Atom Mixture

[2]

(b) Which diagram best represents carbon dioxide? Explain your answer.



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[2]

Dry ice is the solid form of carbon dioxide and has a sublimation point of $-78.5\text{ }^{\circ}\text{C}$.



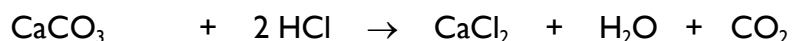
Reference: <https://longbeachice.com/7-practical-lesser-known-uses-dry-ice/>

(c) Suggest the best way to store dry ice. Explain your answer.

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[2]

Carbon dioxide can be produced when calcium carbonate reacts with hydrochloric acid. Below is the chemical equation for the reaction:



(d) One of the products is carbon dioxide. Name the other two products.

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[2]

A student can measure the rate of reaction for calcium carbonate and hydrochloric acid by collecting the carbon dioxide produced.

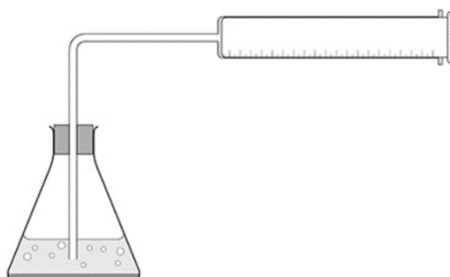
(e) They need to measure out 20 cm³ of hydrochloric acid. What would be the most suitable apparatus to do this?

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[1]

They set up the apparatus to collect the carbon dioxide in the following way:

Figure 1



Reference: AQA

(f) Identify the problem with the setup of the apparatus.

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[1]

- (g) The student measured the volume of CO₂ (cm³) produced every 30 seconds for 4 minutes. Construct a suitable results table for them to record their data.

[3]

The student can determine the mean rate of reaction using the following equation:

$$\text{rate of reaction} = \frac{\text{Volume of gas formed}}{\text{time taken}}$$

- (h) Use the equation above and the results table to determine suitable units for the rate of reaction.

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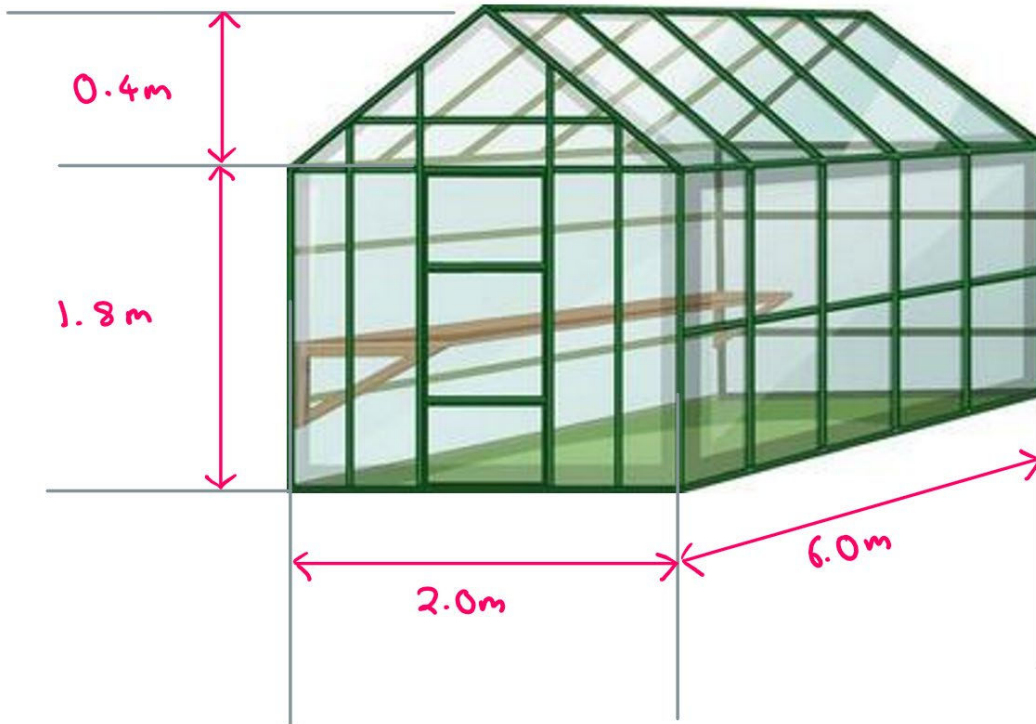
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[2]

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Q3. The dimensions of the greenhouse are shown below.



(a) Find the volume of the greenhouse.

Volume = m³

[3]

(b) What is the mass of the air inside the greenhouse?

The density of air is 1.2 kg/m^3

You may use the equation: $density = \frac{mass}{Volume}$

Mass: kg
[1]

(c) Over the course of the day the greenhouse gets hotter. State and explain how the mass of the air in the greenhouse varies as the temperature rises if:

(i) The windows and door remain closed.

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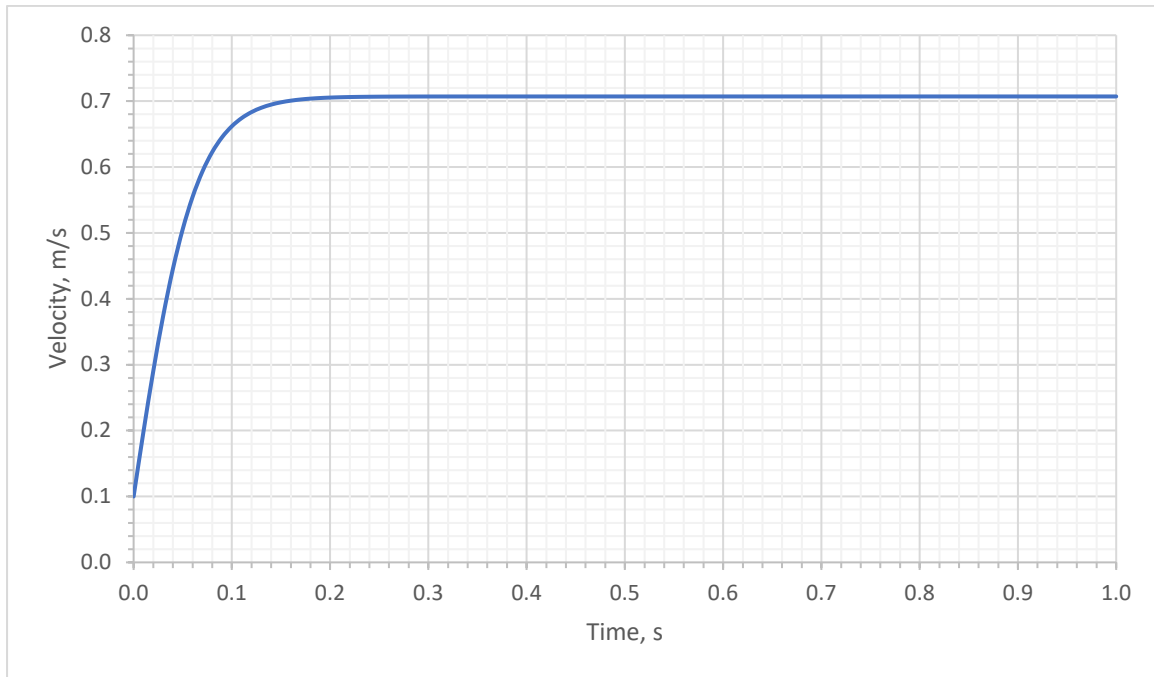
(ii) The windows are open.

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[3]

Q4. At the beginning of Autumn leaves die and fall to the ground under the influence of gravity.

The graph plots the speed of a falling leaf during its first second of fall.



(a)

(i) Describe how the velocity of the leaf changes over the first second.

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(ii) Explain why the velocity changes as shown in the graph.

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[3]

(b) Use the graph to estimate the acceleration of the leaf during the first 0.1 seconds.

You may use the equation:

$$acceleration = \frac{change\ in\ velocity}{time\ taken}$$

Answer: m/s²
[2]

(c) Draw two further lines on the graph, to illustrate:

- (i) The velocity- time behaviour for a leaf with the same mass but double the cross-sectional area. Label this line A.
- (ii) The velocity-time behaviour for a leaf with the same cross-sectional area but double the mass. Label this line B.

[3]

PERIODIC TABLE OF ELEMENT

1	H Hydrogen 1	2	He Helium 4	3	Li Lithium 9	4	Be Beryllium 9	5	B Boron 11	6	C Carbon 12	7	N Nitrogen 14	8	O Oxygen 16	9	F Fluorine 19	10	Ne Neon 20																
11	Na Sodium 23	12	Mg Magnesium 24	13	Al Aluminium 27	14	Si Silicon 28	15	P Phosphorus 31	16	S Sulfur 32	17	Cl Chlorine 35.5	18	Ar Argon 40	19	K Potassium 39	20	Ca Calcium 40																
21	Sc Scandium 45	22	Ti Titanium 48	23	V Vanadium 51	24	Cr Chromium 52	25	Mn Manganese 55	26	Fe Iron 56	27	Co Cobalt 59	28	Ni Nickel 59	29	Cu Copper 64	30	Zn Zinc 65																
37	Rb Rubidium 86	38	Sr Strontium 88	39	Y Yttrium 89	40	Zr Zirconium 91	41	Nb Niobium 93	42	Mo Molybdenum 96	43	Tc Technetium 98	44	Ru Ruthenium 101	45	Rh Rhodium 103	46	Pd Palladium 106	47	Ag Silver 108	48	Cd Cadmium 112	49	In Indium 115	50	Sn Tin 119	51	Sb Antimony 122	52	Te Tellurium 128	53	I Iodine 127	54	Xe Xenon 131
55	Cs Cesium 133	56	Ba Barium 137	57	La Lanthanum 139	58	Ce Cerium 140	59	Pr Praseodymium 141	60	Nd Neodymium 144	61	Pm Promethium 147	62	Sm Samarium 150	63	Eu Europium 152	64	Gd Gadolinium 157	65	Tb Terbium 159	66	Dy Dysprosium 163	67	Ho Holmium 165	68	Er Erbium 167	69	Tm Thulium 169	70	Yb Ytterbium 173	71	Lu Lutetium 175		
87	Fr Francium 223	88	Ra Radium 226	89	Ac Actinium 227	90	Th Thorium 232	91	Pa Protactinium 231	92	U Uranium 238	93	Np Neptunium 237	94	Pu Plutonium 244	95	Am Americium 243	96	Cm Curium 247	97	Bk Berkelium 247	98	Cf Californium 249	99	Es Einsteinium 254	100	Fm Fermium 253	101	Md Mendelevium 256	102	No Nobelium 254	103	Lr Lawrencium 257		
105	Uup Ununpentium 288	106	Uuq Ununquadium 293	107	Uuh Ununhexium 295	108	Uuo Ununoctium 294	109	Uue Ununseptium 292	110	Uuq Ununquadium 291	111	Uuh Ununhexium 289	112	Uuo Ununoctium 286	113	Uue Ununseptium 284	114	Uuq Ununquadium 289	115	Uuh Ununhexium 285	116	Uuo Ununoctium 282	117	Uue Ununseptium 280	118	Uuq Ununquadium 277	119	Uuh Ununhexium 276	120	Uuo Ununoctium 271	121	Uue Ununseptium 270	122	Uuq Ununquadium 269

123	Uut Ununtrium 288	124	Uuq Ununquadium 289	125	Uuh Ununhexium 290	126	Uuo Ununoctium 291	127	Uue Ununseptium 292	128	Uuq Ununquadium 293	129	Uuh Ununhexium 294	130	Uuo Ununoctium 295	131	Uue Ununseptium 296	132	Uuq Ununquadium 297	133	Uuh Ununhexium 298	134	Uuo Ununoctium 299	135	Uue Ununseptium 300	136	Uuq Ununquadium 301	137	Uuh Ununhexium 302	138	Uuo Ununoctium 303	139	Uue Ununseptium 304	140	Uuq Ununquadium 305
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